REMARKS

The invention is a method for modeling fluid flows in a fractured multiplayer porous medium to simulate interactions between pressure and flow rate variations in a well through the medium. The method discretizes the fractured medium by a mesh pattern with fracture meshes centered on nodes at fracture intersections with each node being associated with a matrix volume. Flows are determined between each fracture mesh and the associated matrix volume in a pseudosteady state.

The drawings stand objected to in sections 3 through 3-3. Submitted herewith are substitute Figs. 1-4 which address the objections set forth in sections 3, 3-1 and 3-2.

Also submitted herewith are proposed figures 5 and 6 which are submitted in response to section 3-3 of the objection to the drawings.

The specification has been amended to improve its form for reexamination including describing newly proposed Figs. 5 and 6 and to address the objections noted in sections 4, 4-1, 4-2 and 4-3.

Newly submitted claims 7-12 have been drafted to overcome the stated grounds of objection and the grounds of rejection on indefiniteness.

Claims 1-6 stand rejected under 35 USC §112, first paragraph, as being based upon a non-enabling specification. Specifically, the Examiner concludes as follows:

> For example, as described in lines 12-14 of page 12, "The pore volumes of the fracture meshes and of the matrix blocks (Φ_i) are known by means of the mesh pattern", however, the pore volumes calculation of the fracture meshes has not been disclosed in the specification. The porosity of fracture meshes has not been provided as input data. Accordingly, it would require undue experimentation for one skilled in the

art to make and/or the invention when calculating the accumulation term (A_i) of the fracture mesh as shown in equations at page 14.

This ground of rejection is traversed for the following reasons. Apparently, the Examiner considers the absence of input data to be a significant deficiency in the description of the invention in the portion of the specification to which the Examiner refers. In the first place, the Examiner is referred to "5) Simulation input data" in paragraph [0057] of the Substitute Specification where it is stated that "[t]he geometry of the fracture network and the attributes of the fractures (conductivity) are given in the form of a file as in the method described in the aforementioned U.S. Patent 6,023,656". It is therefore seen that the practice of the invention has been described in conjunction with the providing of input data. As the Examiner recognizes input data is required regarding the fractures with the specification teaching that the input data involves the geometry. In this regard, the Examiner should note that the U.S. patent number of the assignee has been inserted in the portion of the specification referred to by the Examiner in place of the corresponding French patent of the assignee. Moreover, to address the Examiner's point the paragraph containing the referenced portion has been amended to amplify how the input data would be used by a person of ordinary skill in the art to calculate pore volumes from the input of the geometry of the fractures.

It is submitted that the original specification contains adequate information to enable a person of ordinary skill in the art to practice the invention pertaining to pore volume calculation and porosity of fracture meshes.

Claims 1-2 and 4-5 stand rejected under 35 USC §103 as being unpatentable over GB 2322948 in view of the Jones, et al. publication "Control-Volume Mixed Finite

Element Methods" from Computational Geosciences. This ground of rejection is traversed for the following reasons.

It is noted that the Examiner concludes that Cacas, et al. fail to expressly disclose that each node is assigned with a matrix volume, the matrix volume associated with each fracture mesh is delimited in each layer by all of the points that are closer to the corresponding node than to neighboring nodes and the pressure varies linearly as a function of the distance. To cure the deficiencies, the Examiner cites Jones, et al. with the principle reliance in Jones, et al. having been placed on page 4, line 40 through line 1 of page 5.

It is submitted that the Examiner has incorrectly interpreted the teachings of Jones, et al. In the first place, the only mentioning of fractures in Jones, et al. is in the abstract, where a general reference is made to "[l]arge-scale irregularities of the geology (faults, fractures, and layers) suggest the use of irregular grids in simulation". However, it is submitted that this statement is made with respect to the general state of irregular grids while the actual discussion in Jones, et al. contains not a single reference regarding fracture mediums. The text of Jones, et al. discloses a single medium or matrix and determines flows between matrix grid elements. However, the claimed invention determines flows between each fracture mesh and the associated matrix volume with the meshes being centered on nodes at fracture intersections. As stated above, Jones, et al. pertains to a non-fractured medium and determines flows between matrix grid elements and therefore is not relevant to the claimed invention.

Furthermore, the terminology nodes as set forth in Jones, et al. is used in a different manner to name the centers of matrix meshes. As pointed out above the

claimed meshes are centered on nodes at fracture intersections which have no counterpart in Jones, et al.

It is submitted that the Control-Volume Mixed Finite Element Methods disclosed by Jones, et al. can not be used to compute flows between fractures and matrix media. Moreover, Jones, et al. does not pertain to the aforementioned determination of flows between each matrix mesh and the associated matrix volume in a pseudosteady state.

It is submitted that the respective methodologies employed by Cacas, et al. as described by the Examiner and Jones, et al. address totally different concepts. The methodology utilized by Cacas, et al. pertain to the claimed subject area defined in claims 7-12 that as noted by the Examiner differ from the claims in significant aspects. The citation of Jones, et al., in view of there being no description therein of any application pertaining to determining flows between each fracture mesh and the associated matrix volume in a pseudosteady state, will not cure the deficiencies recognized by the Examiner as stated in the first Office Action.

The methodology disclosed by Jones, et al. is not applicable to determining flows between each fracture mesh and an associated matrix volume for the reason that the described methodology uses a single medium or matrix. The text of Jones, et al. beginning on page 4 line 40 through the top of page 5 does not suggest an application to nodes at fracture intersections as recited in the claims. The reference to nodes, which is terms of a "vertex" at the bottom of page 4, is not the claimed nodes at fracture intersections and the reference to the control volume is not a reference to an associated matrix volume which is related to a fracture mesh as recited in the claims.

The dependent claims define further aspects of the present invention which are not rendered obvious by the combination of Cacas, et al. and Jones, et al.

Claims 3 and 6 stand rejected under 35 USC §103 as being unpatentable over United States Patent 6,023,656 in view of GB 2322949 and the equivalent United States Patent 6,064,944. This ground of rejection is traversed for the following reasons. The Examiner concludes that Cacas, et al., as stated in the rejection of claims 1, 2, 4 and 5, does not expressly disclose each node being associated with a matrix volume. The Examiner then goes on to conclude that Sarda, et al. at page 7, lines 5-12 disclose that each node is associated with a matrix volume. It is submitted that this conclusion is incorrect.

As pointed out above in the claims, each fracture mesh is centered on nodes at fracture intersections with flows being determined between each fracture mesh and the associated matrix volume in a pseudosteady state.

The Examiner correctly observes that Sarda, et al. discloses a method based on pixel representation of the medium. However, that pixel representation does not disclose that fracture meshes are centered on nodes as required by the claims. It appears that the Examiner is interpreting a node to be a pixel which does not meet the subject matter of claim 7 and therefore the subject matter of claim 9 which is dependent on claim 8 which is dependent on claim 7.

The disclosure in Sarda, et al. on page 7 lines 5-12 states that the method of Sarda, et al. has an application for determining an image of a porous geological medium crossed by an irregular fracture network. This does not suggest the relationship of fracture meshes centered on nodes at fracture intersections and further

determining flows between each fracture mesh and the associated matrix volume in a pseudosteady state.

It is submitted that a person of ordinary skill in the art would not achieve subject matter of claims 7 and 9 based upon the combination of Cacas, et al. and Sarda, et al. There is no teaching in Cacas, et al. or in the secondary reference Sarda, et al. of fracture meshes centered on nodes at fracture intersections with each node being associated with a matrix volume and determining flows between each fracture mesh and the associated matrix volume in a pseudosteady state.

Moreover, it is submitted that the combination is based upon impermissive hindsight, given the different methodology involved of modeling of the claimed invention pertaining to fracture meshes centered on nodes at fracture intersections with each node being associated with a matrix volume and Sarda, et al. which pertains to pixels. Accordingly, the proposed combination will not objectively be made by a person of ordinary skill in the art to meet the subject matter of claims 7 and 9.

In view of the foregoing amendments and remarks, it is submitted that claims 7-12 are in condition for allowance. Accordingly, early allowance thereof is respectfully requested.

To the extent necessary, Applicants petition for an extension of time under 37 CFR § 1.136. Please charge any shortage in fees due in connection with the filing of

this paper, including extension of time fees, to the Deposit Account No. 01-2135 (Case No. 612.37806X00) and please credit any excess fees to such Deposit Account.

Respectfully submitted,

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